E7.3 10933
CR-133604

TYPE I REPORT #5

SEPT. 3, 1973

A. TITLE OF INVESTIGATION: Multispectral Signatures in Relation to Ground Control Signatures Using Nested-Sampling Approach

B. PROPOSAL #637: GSFC #UN142

C. ABSTRACT OF OBJECTIVES: Determine daily seasonal, meteorological, angular and statistical variation in spectral signatures for different geological target types; relation, intergration and correlation of data from ground, aircraft, and ERTS radiometric equipment for the various target types leading to their improved identification from ERTS images.

D. PRINCIPAL INVESTIGATORS:

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E. TECHNICAL MONITOR:

E.W. CRUMP
Goddard Space Flight Center
Greenbelt, Maryland 20771

PHONE: (301) 982-2857

F. PERIOD: July 3, 1973 - Sept. 2, 1973

G. ACTION REQUIRED:

SEPT. 3 -ADDITIONAL TAPES ARE NEEDED TO CONTINUE WORK ON SHADE PRINTING AND TRANSMISSION MEASUREMENTS ON SELECTED GEOLOGICAL SITES- SEE DATA REQUEST FORM (D). ALL TAPE REQUESTS SHOULD BE CONSIDERED AS ESSENTIAL TO OUR CONTINUED STUDY. ONLY THREE (3) HAVE BEEN RECEIVED TO DATE.

REMOTE SENSING LABORATORY
STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94305

(E73-10933) MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURES USING NESTED-SAMPLING APPROACH Progress Report, 3 Jul. - 2 Sep. 1973 (Stanford Univ.) 12 p HC $3.00 CSCL 05B

N73-30275

Unclas
G3/13 00933

H. SIGNIFICANT RESULTS (Relationship to applications or operational problems, including estimates of the cost benefits of any significant results)

NONE

I. PROBLEMS IMPEDING PROGRESS

1. Tapes are required to continue the computer processing of radiance data. See attached copy of Data Request Form (D). Without tapes we cannot continue to process the spacecraft data, to compare with our ground control data.

2. The length of time between ERTS image acquisition and our receipt of the images at Stanford. We are only now (late August-early September) receiving the mid-June images, for which we have field data.

2

NDPF USE ONLY

D
N
ID
AA
TM

DATA REQUEST FORM

D TAPES

1. DATE August 21, 1973

2. USER ID UN 142

4. SHIP TO: R.J.P. LYON

ADDRESS SCHOOL OF EARTH SCIENCES

STANFORD UNIVERSITY

STANFORD, CALIFORNIA 94305

5. TELEPHONE NO. (415)321-2300 ext 4147/2747 ☐ NEW

6. CATALOGUES DESIRED

STANDARD ☐ U.S. ☐ NON-U.S.

DCS ☐

MICROFILM ☐ U.S. ☐ NON-U.S.

APPROVAL TECHNICAL MONITOR

ADDDHHMMSS OBSERVATION IDENTIFIER	C CENTER POINT COORDINATES	B SENSOR BAND	P PRODUCT TYPE	F PRODUCT FORMAT	T TICK MARKS	NN NUMBER OF COPIES	A AREA
1290-18130	3607N/12104W	4-7	D	9			
1091-18055	3858N/11826W	4-7	D	9			
1255-18183	3730N/12201W	4-7	D	9			
1254-18125	3729N/12037W	4-7	D	9			
1074-18114	3728N/12017W	4-7	D	9			
1075-18170	3855N/12116W	4-7	D	9			
1307-18064	3734N/11906W	4-7	D	9			
1235-18070	3728N/11907W	4-7	D	9			
1055-18055	3722N/11857W	4-7	D	9			

J. DISCUSSION OF ACCOMPLISHMENTS DURING PERIOD:

1. Field Measurements

The truck mounted mobile system was used for seven data collection missions of which two intentionally coincided with ERTS over passes (#1345 and #1363). The pass (#1381) occured while the local "summer-morning" fog obscured the area and hence no field data was taken. (Details see Table I)

At this time of the year (mid-summer) most of the native grasses are dead, and except for the golf courses (which are watered regularly) there is little change in spectral reflectance between soil types and between successive ERTS over passes. The mid winter and spring time are by far the most diagnostic for local soil types, particulary when seen in band 7.

Problems with the tape recorder failure (07/21/73) and its subsequent repair period coupled with the hiatus in spectral change mentioned above have caused us to halt field work and turn our attention to software development.

TABLE I

FIELD MEASUREMENTS - TAPED DATA

DATE	SPECTRAL GROUPS*	TERRAIN TYPE	ERTS OVERPASS (1018 HRS: LOCAL)	TIME HRS (PDT)
07/01/73	48	Roof top irradiance	None	1600-Sunset
07/02/73	78	Roof top reflection	None	1549-2143
07/03/73	80	Soil/grass(stationary and truck-mobile)	1345	114-1321
07/05/73	18	Soil/grass (stationary and truck-mobile)	None	1226-1314
07/07/73	22	Soil/grass (mobile across 1.1 miles of terrain)	None	1334-1449
07/13/73	24	Reflectance Stds black-top road etc.	None	1655-1718
07/14/73	108	Truck mobile over 2.5 miles of terrain	None	1547-1733
07/20/73	18	Local test, lawn and dead grass	None	1613-1703
07/21/73	30*	Soil/grass truck stationary owing to tape recorder failure All hand recorded as single spectra.	1363	110-1158
08/08/73	-	Early morning coastal fog precluded data collection during the ERTS overpass - 1381		

* A spectral group normally averages 20-150 spectra to yeild 1 set of means and 1 set of SD for each channel.

2. Software Development

a. Conversion of Field Data to Radiance Units

The data collected, either by hand or the data system, from the EGTR radiometers are in the form of voltages output from 4 calibratable detector-amplifier systems, one in each of the ERTS bands. Each unit thus is calibrated (using the standard lamp in our ISCO calibration unit) so that correction factors may be applied to the voltage data. When the diffusing discs are in place irradiance values can be obtained in watts. cm^{-2}. When the 15° FOV (or 1° FOV) lenses are in place, the apertured units then read radiance, in watts. $cm^{-2}.ster^{-1}$.

Details see Table II attached (EXOTECH)

b. ERTS Tape Reading to Form Shade Prints

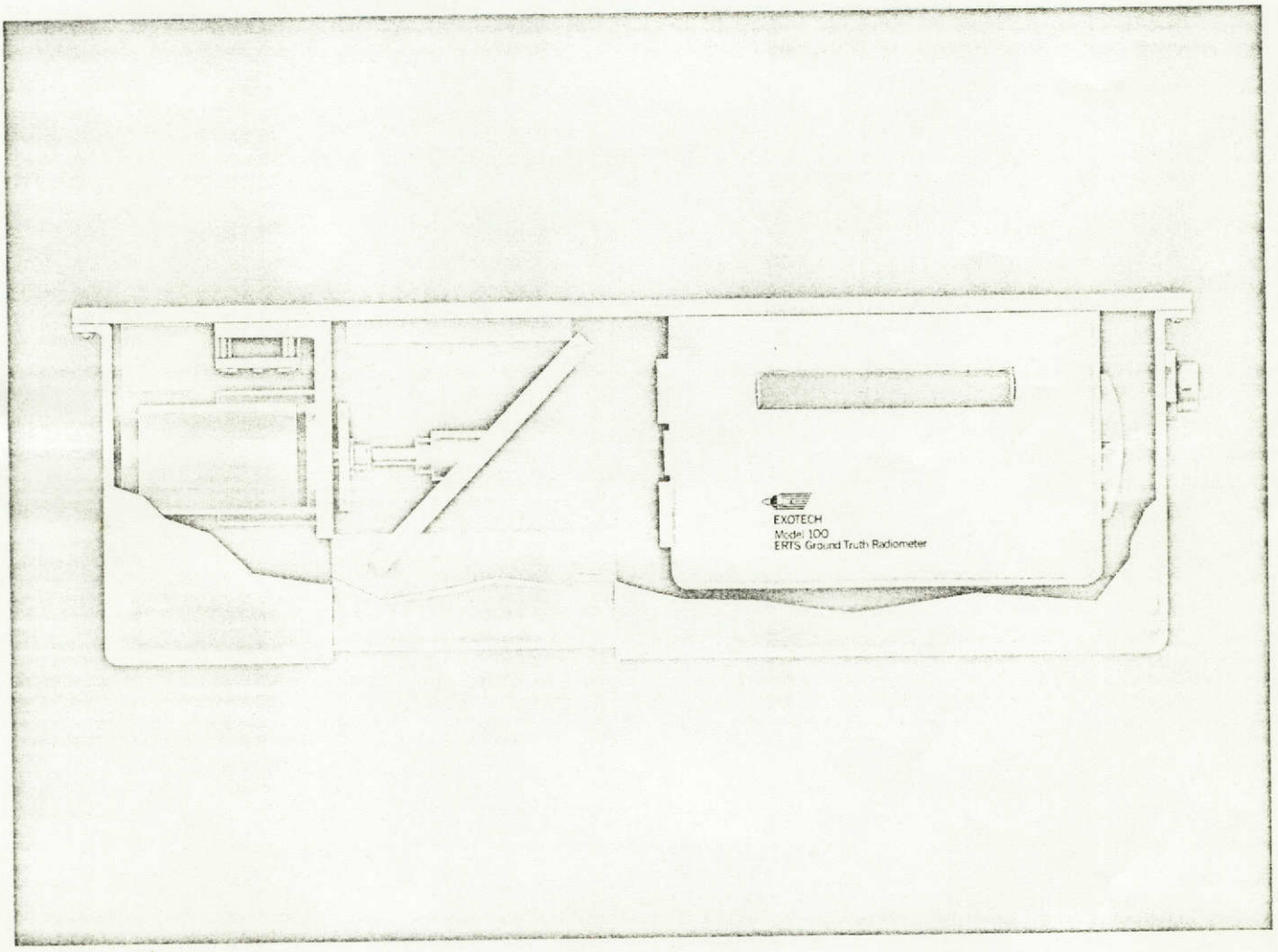
This work was continued with increasing ability to locate any specific area and conversely to derive the tape-cordinates of any required pixel.

Only one tape is on hand for Stanford, and two for the Mono Lake Node, so our work has been restricted to these dates only.

TABLE II 6

Exotech Incorporated
1200 Quince Orchard Boulevard
Gaithersburg, Maryland 20760
301 948-3060
TWX 710-828-9746

ERTS Ground Truth Radiometer/Airborne Scanner* Model 100



The Model 100 is specially designed to supply an ERTS experimenter with either airborne or manually obtained Ground Truth data which identically matches spatially and spectrally, the ERTS Multi Spectral Scanner (MSS) data. The instrument uses the identical four spectral filters employed in the spacecraft system to provide four simultaneous channels of accurately calibrated radiometric data of both downwelling (incident) and reflected radiation. The Model 100 system was designed by personnel who have extensive experience in remote field measurements and embodies the concepts of ruggedness and simplicity in a portable, precision instrument.

*With Accessory Model 101 Scanner Module.

Detailed Description

Spectral Bands	Four channels reproducing the ERTS MSS bandpasses (0.5 to 0.6 microns; 0.6 to 0.7 microns; 0.7 to 0.8 microns; and 0.8 to 1.1 microns). Glass absorption filters are used to correct the silicon detectors to simulate the ERTS photomultiplier response curves. Thin film filters procured to ERTS specifications are then added to precisely reproduce the ERTS bandpasses.
Field of View	Three modes of operation: 1) 15° circular field of view for near terrain measurements 2) 1° square field of view to observe the 260 foot square resolution element of ERTS from aircraft altitude 3) 2π steradian field of view for measuring downwelling (incident) radiation
Calibration Accuracy	Calibrated using precision light sources and reflectance standards. An absolute accuracy of ± 5% is maintained over the entire operational environmental range. Recalibration will not be required for periods of one year or more under typical use conditions.
Outputs	Four independent low impedance (1000 ohm), high level (5 volts full scale) outputs. Case isolation provided. May be shorted to ground or each other without damage to instrument. Electrical bandpass of 0-500 Hz ensures high data rate capability with low noise operation.
Controls	Only two controls for "idiot proof" field use. 1) Six position switch ("OFF", each of the four channels and "Battery Check" for display on the instrument meter) 2) Selector switch for "Incident" and "Reflectance" measurements
Sight	Precision 1.0 power, erect image scope having an internal reticle delineating the 15° and 1° fields of view. Still and movie photography of the target area can be accomplished through this sight.

MSS GROUND TRUTH RADIOMETER
MODEL 100

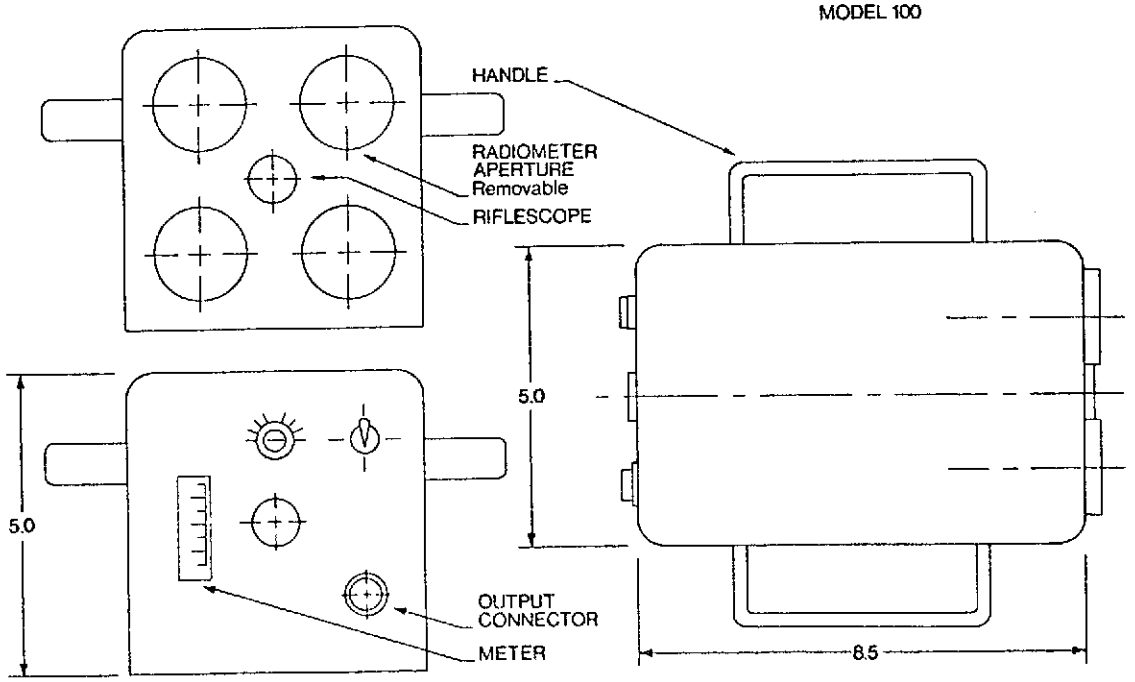


TABLE II CONT. 8

Co-alignment	All channels and the sighting scope are co-aligned to ±0.1°.
Meter	Precision meter monitors four channels and battery condition.
Power Source	Replaceable battery (below -15°C. Battery Life is shortened considerably. An external 9V power source may be used).
Battery Life	100 Hours.
Packaging	1) The meter, controls and connector are all located on the rear panel. Adequate eye relief for the sight permits simultaneous sighting and reading of the meter 2) All corners are rounded and the unit is coated with a special white paint which exhibits *no* temperature rise under worst case solar loading conditions. 3) Handles are located for one hand operation and sighting, as well as carrying convenience.
Sealed Construction	"O" ring sealed for operation in any weather.
Environmental Conditions	Operable within specifications over: 1) - 40°C to + 50°C 2) 0-100% relative humidity 3) shock and vibration as typical in field and aircraft environments. 4) 0 to 100,000 feet altitude
Mounting	Standard 1/4 - 20 tapped hole for tripod, etc. or for use with an airborne scanner accessory.
Size	5" x 5" x 8 1/2"
Weight	Approximately five (5) pounds with battery.

Accessories for the Model 100

1. AIRBORNE SCANNER (Model 101 Scanner Module) - adjustable scan velocity matches a wide range of V/H to provide a four channel strip map having actual ERTS spatial resolution. (At 15,000 feet the one degree field of view subtends 260 feet on the ground.) Precision shaft angle encoder monitors scan position. This accessory is housed in a windowed pod which accepts the Model 100 with auxiliary photographic camera. The pod may be mounted within an aircraft to view the ground through a port or it may be located externally, requiring minimum modification to the aircraft.

2. CALIBRATION SOURCE - an NBS calibrated Quartz-Halogen lamp is used in conjunction with a precision power supply to provide an intense source of light suitable for calibration of the Model 100. The lamp is housed in a blower-cooled enclosure with special ultra-low reflectance surfaces to stimulate the free-space conditions of initial calibration.

3. REFLECTANCE STANDARDS - precision calibrated reflectance standards of several types are available. These may be used under field conditions.

4. DATA LOGGER - Exotech can provide special digital data loggers with the Model 100 which will provide computer-compatible, digital tapes of airborne or field measurements.

5. REMOTE OPERATION - for use in unattended, extended period applications a "self-cleaning window" housing can be supplied. This permits accurate data to be obtained under severe conditions of dust, rain, snow, etc., where manual window cleaning is not possible.

6. OTHER SPECTRAL BANDS - Exotech can supply the Model 100 with alternate or additional filter sets to match the ERTS RBV responses, EREP experiments, etc.

7. INFRARED ACCESSORY - the 10.4 micron to 12.6 micron band to be covered by the ERTS B MSS is incorporated into an accessory package which can be added to the Model 100 at any time.

K. PLANNING FOR NEXT PERIOD

1. Stanford Node

a. Data collection of bidirectional reflectance of soil/grass targets during ERTS overpass, if area is cloud and fog-free, using EGTR radiometer, and truck mounted data system.

b. Roof top irradiance measurements on clear days between ERTS overpasses.

c. Software development for reading tapes of simultaneous irradiance (EGTR Unit A) and bidirectional reflectance (EGTR Unit B)

d. Software development for reading ERTS digital tapes, into shadow prints and numeric print out, with punched cards.

2. Mono Lake Node

a. Data collection of ERTS overpasses, selected as to weather (i.e. not snowing)

b. Software development of print and of ERTS digital tapes.

L. PUBLISHED MATERIALS

NONE

M. RECOMMENDATIONS FOR CHANGES IN OPERATIONS ADDITIONAL EFFORT OR CORRELATION OF EFFORT/RESULTS OF ERTS

NONE

N. CHANGES IN STANDING ORDER FORMS

NONE

O. DATA REQUEST FORMS SUBMITTED

Attached in front of this document – Section I (Attachment – D)

P. ACCESSION LIST FOR ERTS IMAGERY/TAPES

Attached (over page)

ERTS IMAGES ACQUIRED OVER STANFORD UNIVERSITY TEST AREA

	OBSERVATION ID	FIELD DATA	MICROFILM ROLL NO.	DATE ACQUIRED	CLOUD COVER	ORBIT NUMBER	PRINCIPAL POINT (C) OF IMAGE		SUN AZIM	SUN ELEV	PRODUCTS MADE					(R=REQUESTED) PRODUCTS RECD. AT STANFORD					
							LAT.	LONG.			M	S	B7	P	M9	M	S	B7	P	M9	
1.	1003-18175	-	10001/0126/7	7/26/72	10	42	3805N	12146W	118.7	58.7	x	x	x	x	x	-	-	-	-	-	
2.	1021-18172	-	10001/1226	08/13/72	0	293	3724N	12145W	124.5	55.8	x	x	x	x	x	R	R	R	R	-	
3.	1039-18172	-	10002/0074	08/31/72	0	544	3725N	12150W	132.5	51.9	x	x	x	x	x	R	R	R	R	-	
4.	1057-18172	-	10002/0598	09/18/72	20	795	3721N	12149W	140.2	47.1	x	x	x	x	x	R	R	R	R	-	
5.	1075-18173	-	10004/0236	10/06/72	0	1046	3729N	12144W	146.8	41.6	x	x	x	x	x	4	8	R	1	4	
6.	1093- NO FRAMES TAKEN			10/21/72	-	1297			152.	35.						-	-	-	-	-	
7.	1111-18181	-	10004/1570	11/11/72	60	1548	3715N	12153W	153.9	30.9	x	x		x	x	4	8	-	2	-	
8.	1129-18181	-	10005/0498	11/29/72	20	1799	3725N	12150W	154.6	26.7	x	x		x	x	4	8	-	2	-	
9.	1147-18181	-	10006/0333	12/17/72	90	2050	3718N	12151W	153.4	24.5	x	x	x	x	x	-	-	-	-	-	
10.	1165-18175	-	10006/0898	01/04/73	10	2301	3724N	12146W	151.1	24.2	x	x	x	x	x	4	8	-	2	-	
11.	1183-18175	-	10007/0170	01/22/73	20	2552	3732N	12146W	148.2	26.3	x	x		x		4	8	R	2	R	
12.	1201-18181	-	10007/0782	02/09/73	80	2803	3725N	12151W	144.9	30.5	x	x		x		-	-	-	-	-	
13.	1219-18182	-	10008/0440	02/27/73	100	3054	3726N	12156W	141.6	36.3	x	x		x		-	-	-	-	-	
14.	1237-18183	-	10009/0470	03/17/73	40	3305	3727N	12200W	138.1	42.8	x	x		x		4	8	-	2	-	
15.	1255-18183	-	10009/1329	04/04/73	0	3556	3730N	12201W	134.2	49.4	x	x		x		4	4	-	1	-	
16.	1273-18183	-	10010/0613	04/22/73	0	3807	3736N	12201W	129.4	55.2	x	x		x		4	8	-	-	-	
17.	1291-18182	-	10010/1539	05/10/73	0	4058	3731N	12201W	123.3	59.6	x	x		x		4	4	-	1	-	
18.	1309-18181	F		05/28/73																	
19.	1327-	F		06/15/73																	
20.	1345-18174	F		07/03/73																	
21.	1363	F		07/21/73	0	5062															
22.	1381-			08/08/73		5313															
23.	1399			08/26/73		5564															